

FIG. 1

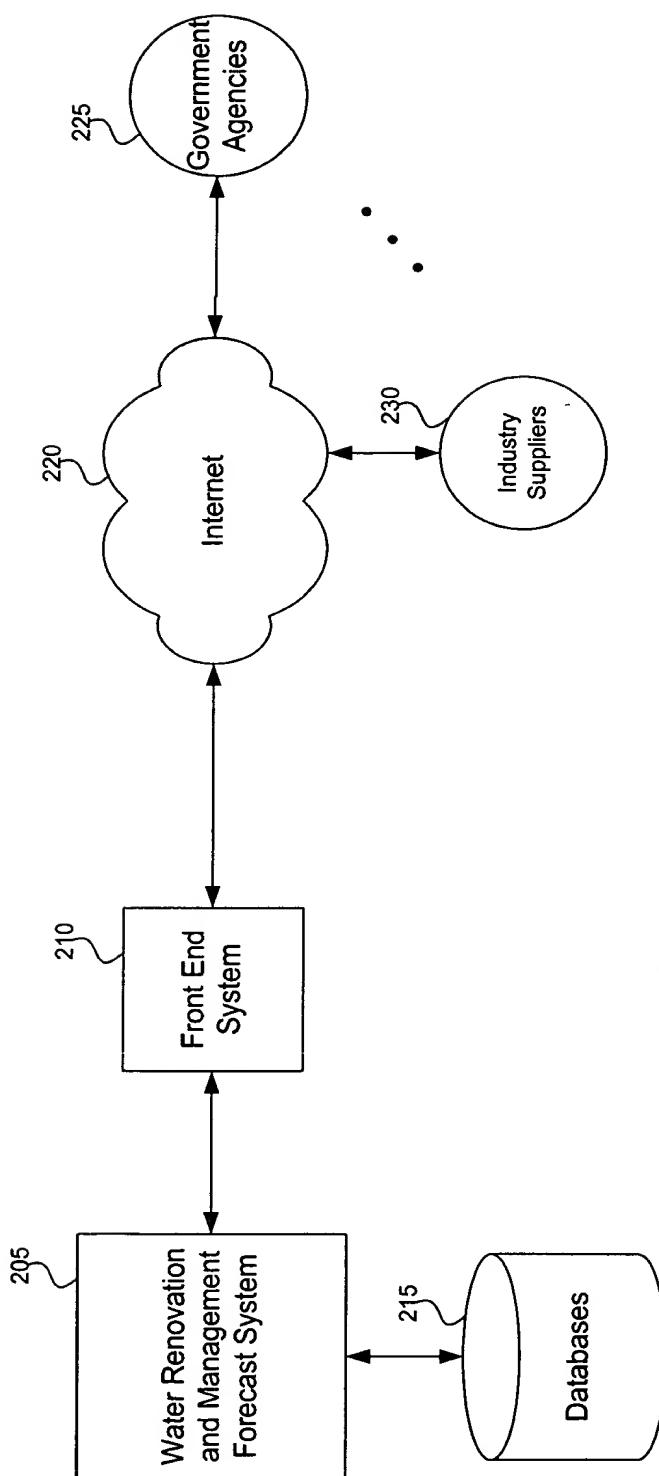
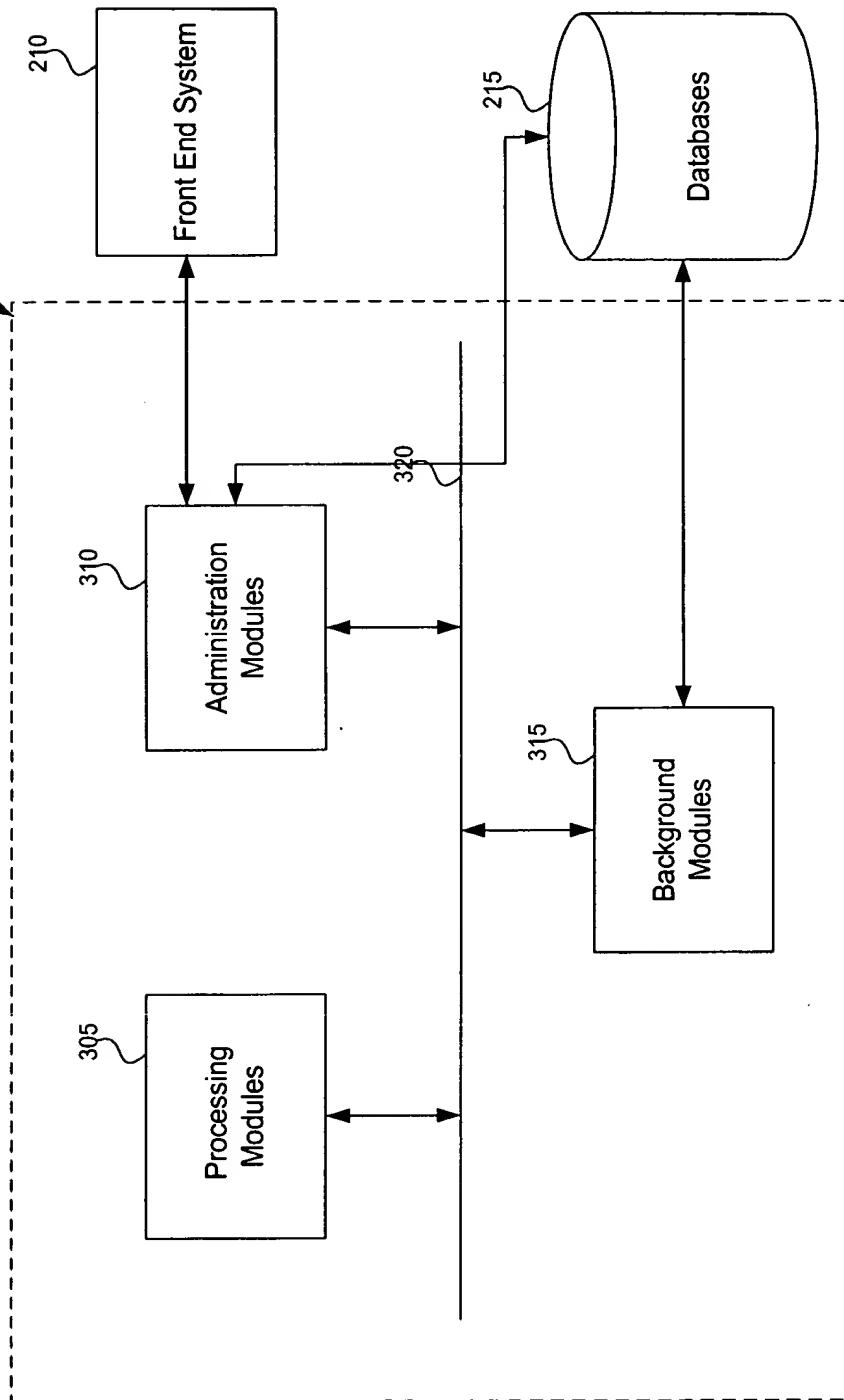
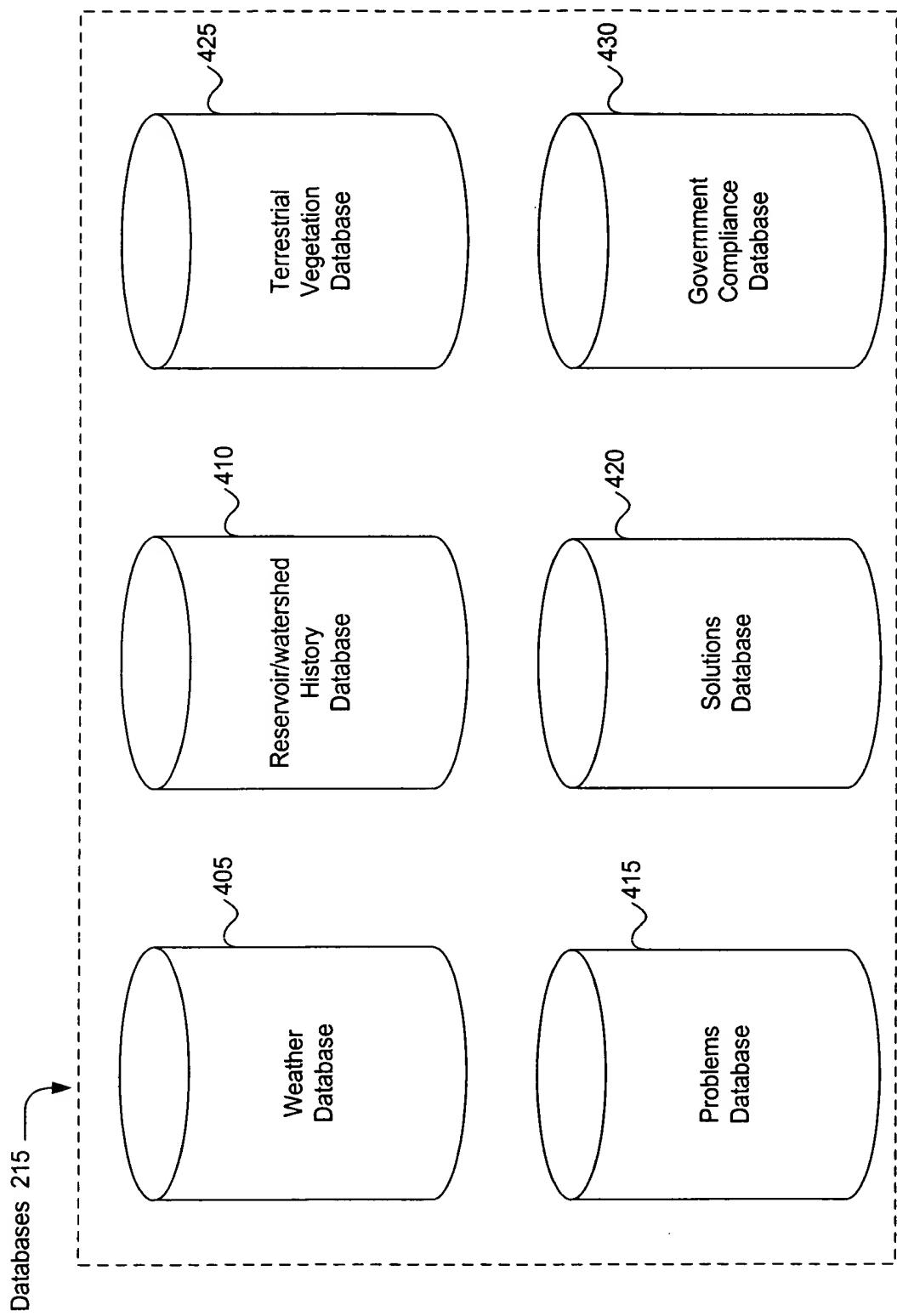


FIG. 2

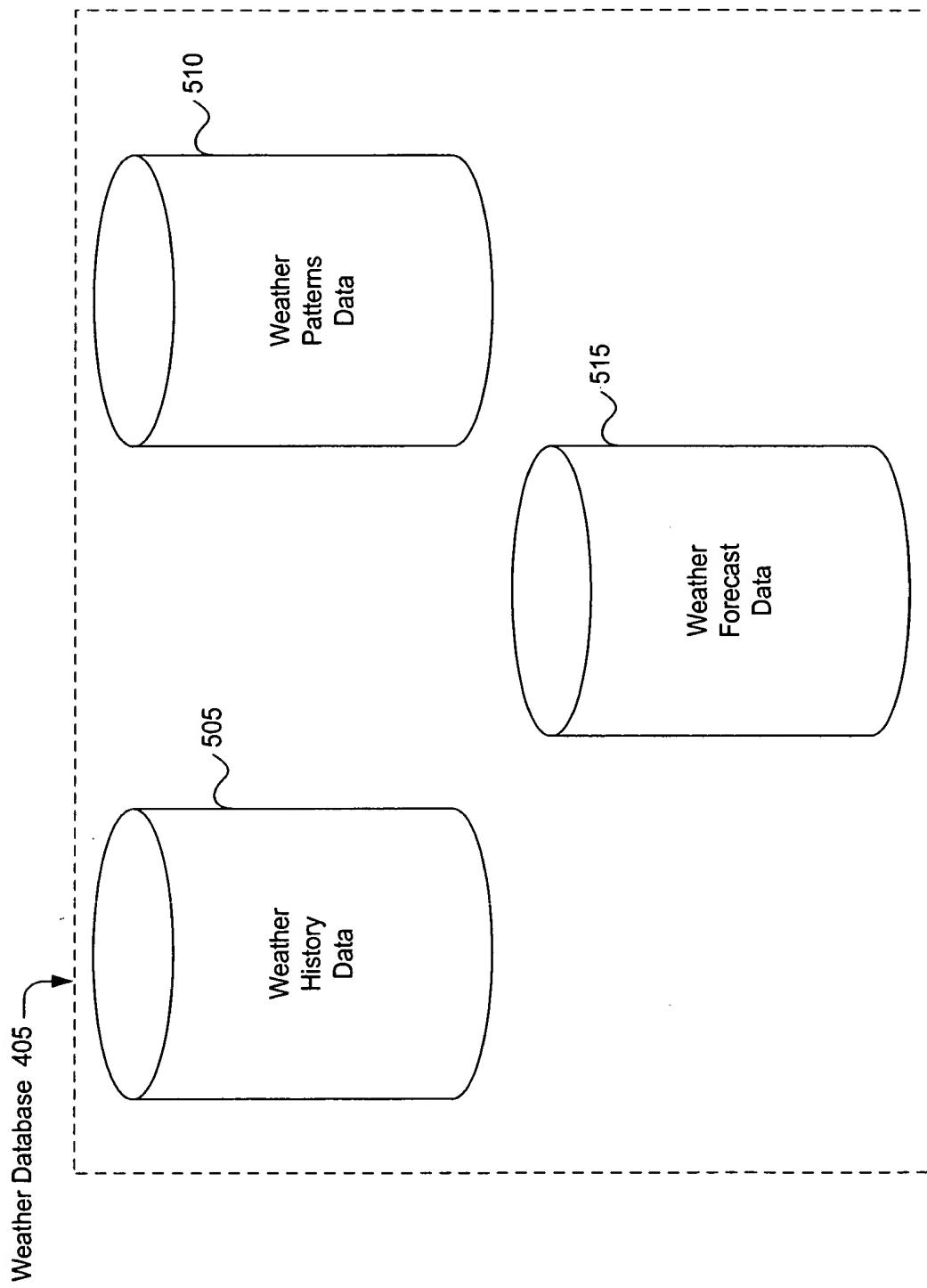
**Water Renovation and Management Forecast System 205**



**FIG. 3**



**FIG. 4**



**FIG. 5**

Weather History Data 505

605 { 610 { 615 { 620 { 622 }

Year	MA	Data Type	Period1	Period2	Period3	Period4	Period5	Period6
:	:	:	:	:	:	:	:	:
1997	MA100	temp_sea	46	47	50	51	49	47
1998	MA100	temp_sea	46	47	49	51	50	48
1997	MA100	prec_sea	1.01	1.03	1.08	1.1	1.12	1.1
1998	MA100	prec_sea	1.01	1.03	1.07	1.1	1.12	1.1
1997	MA100	wind_speed_sea	17	15	5	7	10	14
1998	MA100	wind_speed_sea	16	15	4	7	10	13
1997	MA100	solar_radiation_sea	3.4	4.1	4.2	5.5	4.3	3.8
1998	MA100	solar_radiation_sea	3.4	4.0	4.2	5.4	4.0	3.7
1997	MA100	cloud_cover_sea	75	75	25	25	25	75
1998	MA100	cloud_cover_sea	75	75	25	25	25	75
1997	MA100	cooling_rate_sea	0.2	0.3	0.2	0.2	0.2	0.1
1998	MA100	cooling_rate_sea	0.3	0.3	0.2	0.2	0.2	0.2
1997	MA100	growing_degree_days_sea	24	25	25	21	19	16
1998	MA100	growing_degree_days_sea	24	26	25	21	19	16
:	:	:	:	:	:	:	:	:

FIG. 6A

Weather History Data 505

605 } 610 } 615 } 620 }

623 } }

Year	MA	Data Type	Period1	Period2	Period3	Period4	Period5	Period6
1997	MA100	temp	49	43	45	47	50	42
1998	MA100	temp	53	51	56	50	58	54
1997	MA100	prec	1.5	0.4	0.9	1.3	1.7	0.3
1998	MA100	prec	1.1	0.01	2.68	1.78	0.48	0.01
1997	MA100	wind_speed	15	14	5	7	16	20
1998	MA100	wind_speed	12	15	10	8	18	21
1997	MA100	solar_radiation	3.0	4.1	4.0	5.2	4.3	4.0
1998	MA100	solar_radiation.sea	3.4	4.0	4.5	5.4	4.0	3.7
1997	MA100	cloud_cover	100	75	25	25	25	0
1998	MA100	cloud_cover	75	75	25	25	25	25
1997	MA100	cooling_rate	0.3	0.3	0.2	0.2	0.2	0.1
1998	MA100	cooling_rate	0.3	0.3	0.2	0.2	0.2	0.2
1997	MA100	growing_degree_days	26	27	25	25	19	16
1998	MA100	growing_degree_days	23	26	25	20	19	15
:	:	:	:	:	:	:	:	:

FIG. 6B

Weather History Data 505

605, 610, 615, 620, 625, 627, 630, 633

Year	MA	Data Type
1997	MA100	temp.cat
1998	MA100	temp.cat
1997	MA100	prec.cat
1998	MA100	prec.cat
1997	MA100	wind_speed.cat
1998	MA100	wind_speed.cat
1997	MA100	solar_radiation.cat
1998	MA100	solar_radiation.cat
1997	MA100	cloud_cover.cat
1998	MA100	cloud_cover.cat
1997	MA100	cooling_rate.cat
1998	MA100	cooling_rate.cat
1997	MA100	growing_degree_days.cat
1998	MA100	growing_degree_days.cat
:	:	:

Period6  
Period5  
Period4  
Period3  
Period2  
Period1

FIG. 6C

Weather Patterns Data 510

- TEMPERATURE/PRECIPITATION
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/BELLOW SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/BELLOW SEASONAL
  - BELOW SEASONAL/SEASONAL
  - BELOW SEASONAL/ABOVE SEASONAL
  - BELOW SEASONAL/BELLOW SEASONAL
- TEMPERATURE/SOLAR RADIATION
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/BELLOW SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/BELLOW SEASONAL
  - BELOW SEASONAL/SEASONAL
  - BELOW SEASONAL/ABOVE SEASONAL
  - BELOW SEASONAL/BELLOW SEASONAL
- CLOUD COVER/SOLAR RADIATION
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/BELLOW SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/BELLOW SEASONAL
  - BELOW SEASONAL/SEASONAL
  - BELOW SEASONAL/ABOVE SEASONAL
  - BELOW SEASONAL/BELLOW SEASONAL
- COOLING RATE/SOLAR RADIATION
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/BELLOW SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/BELLOW SEASONAL
  - BELOW SEASONAL/SEASONAL
  - BELOW SEASONAL/ABOVE SEASONAL
  - BELOW SEASONAL/BELLOW SEASONAL
- PRECIPITATION/WIND SPEED
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/BELLOW SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/BELLOW SEASONAL
  - BELOW SEASONAL/SEASONAL
  - BELOW SEASONAL/ABOVE SEASONAL
  - BELOW SEASONAL/BELLOW SEASONAL

...

FIG. 7A

Weather Patterns Data 510

- SUSTAINED WEATHER
  - TEMPERATURE SUSTAINED 2 PERIODS
  - TEMPERATURE SUSTAINED 3 PERIODS
  - PRECIPITATION SUSTAINED 2 PERIODS
  - PRECIPITATION SUSTAINED 3 PERIODS
  - WIND SPEED SUSTAINED 2 PERIODS
  - WIND SPEED SUSTAINED 3 PERIODS
  - SOLAR RADIATION SUSTAINED 2 PERIODS
  - SOLAR RADIATION SUSTAINED 3 PERIODS
  - CLOUD COVER SUSTAINED 2 PERIODS
  - CLOUD COVER SUSTAINED 3 PERIODS
  - COOLING RATE SUSTAINED 2 PERIODS
  - COOLING RATE SUSTAINED 3 PERIODS
  - GROWING DEGREE DAYS SUSTAINED 2 PERIODS
  - GROWING DEGREE DAYS SUSTAINED 3 PERIODS
- TEMPERATURE/PRECIPITATION LAG 1 PERIOD
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/Below SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/Below SEASONAL
  - Below SEASONAL/SEASONAL
  - Below SEASONAL/ABOVE SEASONAL
  - Below SEASONAL/Below SEASONAL
- TEMPERATURE/SOLAR RADIATION LAG 1 PERIOD
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/Below SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/Below SEASONAL
  - Below SEASONAL/SEASONAL
  - Below SEASONAL/ABOVE SEASONAL
  - Below SEASONAL/Below SEASONAL
- CLOUD COVER/SOLAR RADIATION LAG 1 PERIOD
  - SEASONAL/SEASONAL
  - SEASONAL/ABOVE SEASONAL
  - SEASONAL/Below SEASONAL
  - ABOVE SEASONAL/SEASONAL
  - ABOVE SEASONAL/ABOVE SEASONAL
  - ABOVE SEASONAL/Below SEASONAL
  - Below SEASONAL/SEASONAL
  - Below SEASONAL/ABOVE SEASONAL
  - Below SEASONAL/Below SEASONAL

FIG. 7B

Year	MA	Data Type	Period1	Period2	Period3	Period4	Period5	Period6
N+1	MA100	temp_sea	47	49	52	54	55	
N+1	MA100	prec_sea	1.00	1.03	1.06	1.05	1.10	1.1
N+1	MA100	wind_speed_sea	18	14	5	7	11	15
N+1	MA100	solar_radiation_sea	3.4	4.1	4.2	5.4	4.2	3.7
N+1	MA100	cloud_cover_sea	75	75	25	0	25	75
N+1	MA100	cooling_rate_sea	?	?	?	?	?	?
N+1	MA100	growing_degree_days_sea	24	27	27	25	20	17
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
N+1	MA100	temp	48	49	50	53	55	57
N+1	MA100	prec	1.1	1.05	1.05	1.00	1.15	1.2
N+1	MA100	wind_speed	16	16	7	5	16	20
N+1	MA100	solar_radiation	3.5	4.5	4.5	5.5	5.0	4.3
N+1	MA100	cloud_cover	75	25	75	25	0	25
N+1	MA100	cooling_rate	0.2	0.3	0.2	0.2	0.2	0.2
N+1	MA100	growing_degree_days	24	28	26	22	20	16
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

805 ~~~~~ 605 { 610 { 615 { 620 {  
~~~~~ Weather Forecast Data 515 ~~~~~

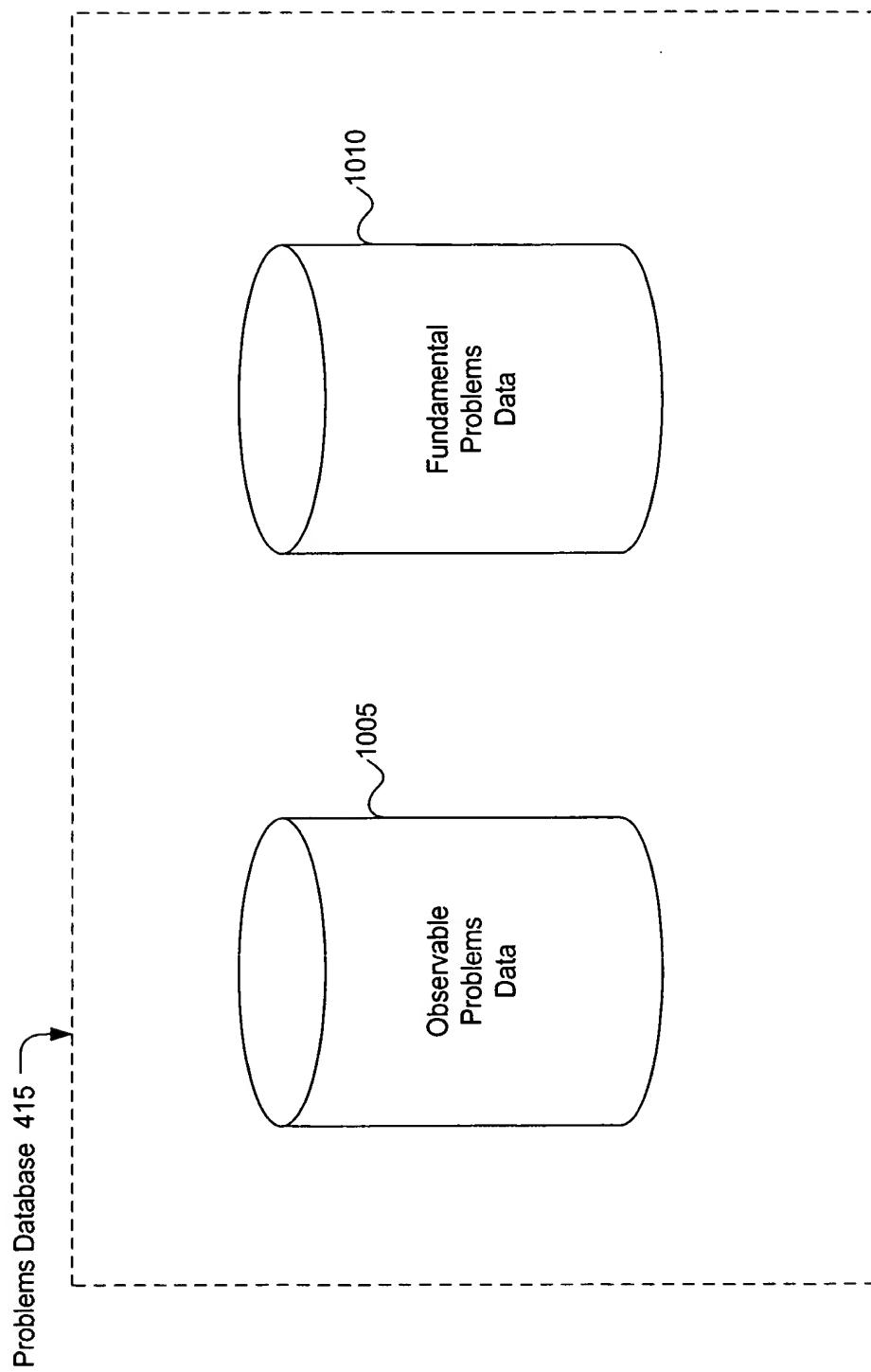
**FIG. 8A**

Weather Forecast Data 515

| Year | MA    | Data Type               | Period1 | Period2 | Period3 | Period4 | Period5 | Period6 |
|------|-------|-------------------------|---------|---------|---------|---------|---------|---------|
| N+1  | MA100 | temp.cat                | 1       | 1       | 1       | 1       | 1       | 1       |
| N+1  | MA100 | prec.cat                | 1       | 1       | -1      | -1      | 1       | -1      |
| N+1  | MA100 | wind_speed.cat          | -1      | 1       | 1       | -1      | 1       | -1      |
| N+1  | MA100 | solar_radiation.cat     | 1       | 1       | 1       | 1       | 1       | 1       |
| N+1  | MA100 | cloud_cover.cat         | 0       | -1      | 1       | 1       | -1      | -1      |
| N+1  | MA100 | cooling_rate.cat        | -1      | 0       | 0       | 0       | 0       | 0       |
| N+1  | MA100 | growing_degree_days.cat | 0       | 1       | -1      | 0       | 0       | -1      |
| ⋮    | ⋮     | ⋮                       | ⋮       | ⋮       | ⋮       | ⋮       | ⋮       | ⋮       |

**FIG. 8B**

FIG. 9



**FIG. 10**

Observable Problems Data 1005

| Observable Problem | Description                             | Related Fundamental/Observable Problems |
|--------------------|-----------------------------------------|-----------------------------------------|
| OP1                | Objectionable Taste and Odor Conditions | OP3, OP6, FP2, FP3, FP4                 |
| OP2                | Declining Wildlife (e.g., fish)         | OP5, OP6, OP8, FP3, FP4                 |
| OP3                | Shallow Water                           | FP3                                     |
| OP4                | Decreased Water Clarity                 | FP3, FP4                                |
| OP5                | Decreased Water Flow                    | FP3, FP4                                |
| OP6                | Excessive Plant Growth                  | FP1, FP4                                |
| :                  | :                                       | :                                       |

**FIG. 11**

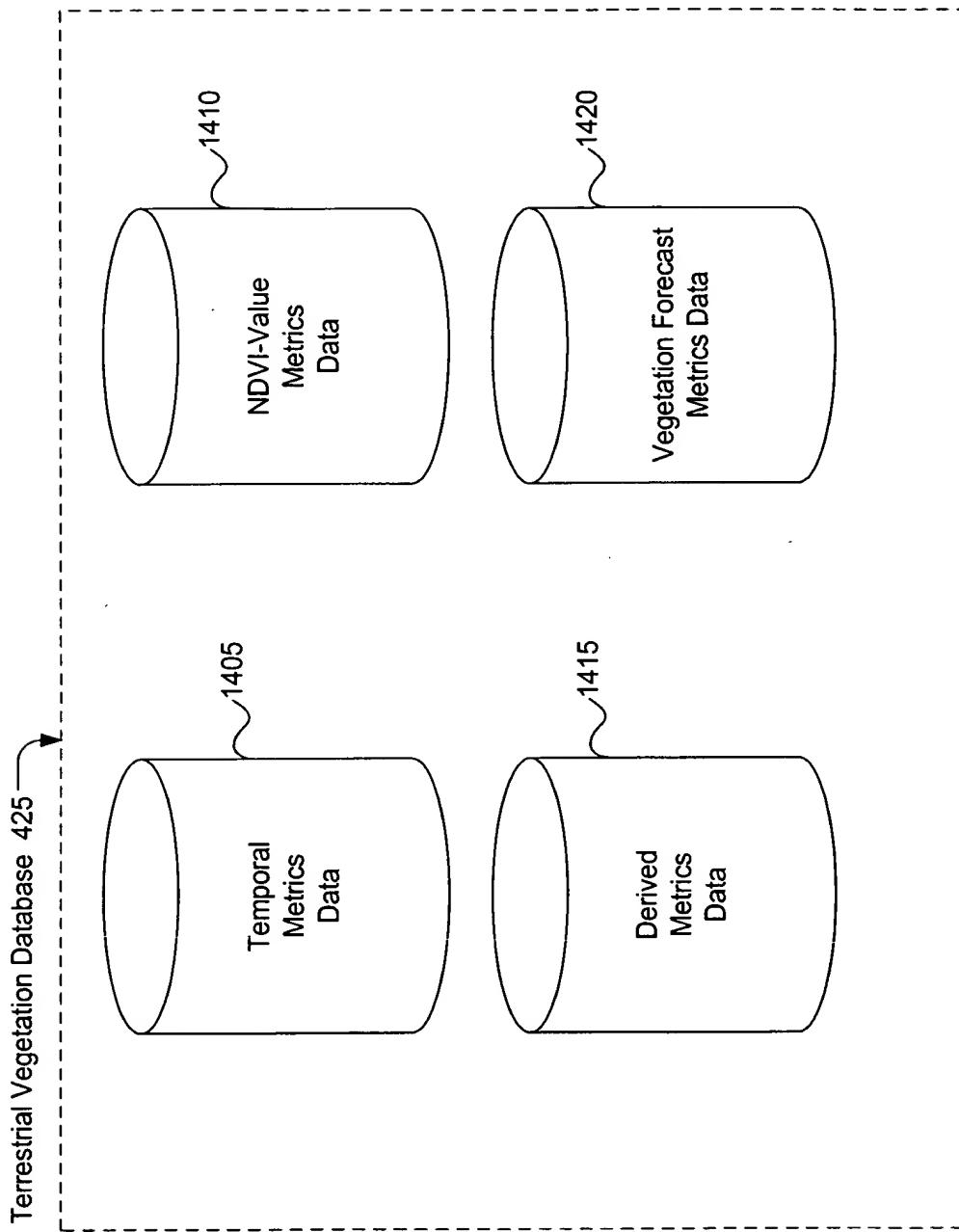
Fundamental Problems Data 1010

| Fundamental Problem | Description                        | Related Weather Causes                                                                                                                                                                                                                    | Related Terrestrial Vegetation Causes                                                     | Possible Solutions (✓) |    |    |    |    |    |
|---------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------|----|----|----|----|----|
|                     |                                    |                                                                                                                                                                                                                                           |                                                                                           | S1                     | S2 | S3 | S4 | S5 | S6 |
| FP1<br>1225         | Elevated Plant Nutrient Levels     | Excessive watershed runoff due to high precipitation and/or high wind speed; high temperature; high solar radiation and/or reduced cloud coverage increasing water temperature, decreasing water circulation, and increasing plant growth | Early season greenness in agricultural areas; Late season greenness in agricultural areas | ✓                      | ✓  |    |    |    |    |
| FP2                 | Elevated Chemical Levels (Geosmin) | High solar radiation, high temperatures, low cooling rate, and/or reduced cloud coverage decreasing water circulation and increasing plant growth                                                                                         | Early season greenness in agricultural areas; Late season greenness in agricultural areas | ✓                      | ✓  | ✓  | ✓  |    |    |
| FP3                 | Siltation                          | Excessive watershed runoff due to high precipitation and/or high wind speed                                                                                                                                                               | Early season greenness in agricultural areas; Late season greenness in agricultural areas | ✓                      | ✓  |    |    |    |    |
| FP4                 | Thermal Stratification             | Warm temperatures in the spring and early summer; High solar radiation, high temperatures, low cooling rate, and/or reduced cloud coverage decreasing water circulation                                                                   |                                                                                           | ✓                      | ✓  |    |    |    |    |
| :                   | :                                  | :                                                                                                                                                                                                                                         |                                                                                           | :                      | :  | :  | :  | :  | :  |

FIG. 12

| Solutions Database 420 |          |                                                                            |       |                 |                  |                      |
|------------------------|----------|----------------------------------------------------------------------------|-------|-----------------|------------------|----------------------|
|                        | Solution | Description                                                                | Term  | Economic Impact | Political Impact | Environmental Impact |
| Physical               | S1       | Adjust Water Level                                                         | short | low             | high             | medium               |
|                        | S2       | Cut Weeds                                                                  | short | medium          | low              | low                  |
|                        | S3       | Dredge                                                                     | long  | high            | low              | low                  |
|                        | S4       | Aeration (Destratification)                                                | short | medium          | low              | low                  |
|                        | S5       | Alter Adjacent Land Use                                                    | long  | high            | high             | high                 |
|                        | S6       | Disinfect (Water Treatment)                                                | long  | high            | low              | low                  |
|                        | S7       | Filter (Water Treatment)                                                   | long  | high            | low              | low                  |
|                        | S8       | Apply different types of fertilizer to crops                               | short | low             | high             | medium               |
|                        | S9       | Apply fertilizer at time sensitive times relating to terrestrial greenness | short | low             | high             | low                  |
|                        | S10      | Introduce Herbicides                                                       | short | medium          | high             | high                 |
| Chemical               | S11      | Introduce Fish                                                             | long  | medium          | low              | low                  |
| Biological             | :        | :                                                                          | :     | :               | :                | :                    |

FIG. 13



**FIG. 14**

FIG. 15

| Year | MA    | NDVI-Value Metrics                                                     |         |                                     |         |                     |         |                         |  |
|------|-------|------------------------------------------------------------------------|---------|-------------------------------------|---------|---------------------|---------|-------------------------|--|
|      |       | 1605                                                                   | 610     | 1610                                | 1615    | 1620                | 1625    |                         |  |
|      |       | Value of Onset of<br>Greenness<br>620                                  |         | Value of End of<br>Greenness<br>620 |         | Maximum NDVI<br>620 |         | Range of<br>NDVI<br>620 |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
|      |       | Period6                                                                | Period5 | Period4                             | Period3 | Period2             | Period1 |                         |  |
| 1998 | MA100 | 115 117 120 119 125 110 20 121 20 118 120 170 168 165 166 166 44 47    | 50      | 50                                  | 48      | 47                  |         |                         |  |
| 1997 | MA101 | 132 133 150 117 130 125 130 118 120 119 119 15 165 166 170 171 169 50  | 51      | 48                                  | 54      | 53                  | 50      |                         |  |
| 1998 | MA101 | 145 151 130 120 125 125 125 119 125 120 120 116 169 170 171 169 170 48 | 51      | 53                                  | 53      | 48                  | 50      |                         |  |
| ...  | ...   | ...                                                                    | ...     | ...                                 | ...     | ...                 | ...     | ...                     |  |

**FIG. 16**

FIG. 17

Vegetation Forecast Metrics Data 1420 ↗

FIG. 18

Government Compliance Database 430

| Type    | State/Locality       | MA(s) Applicable  | Permit Required for Solution (✓) |     |     |     |     |     |     |     |     |
|---------|----------------------|-------------------|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|         |                      |                   | S1                               | S2  | S3  | S4  | S5  | S6  | S7  | S8  | S9  |
| Federal | -                    | MA100 -<br>MA1780 |                                  |     |     |     |     |     | ✓   |     | ... |
| State   | Alabama              | MA201 - MA215     | ✓                                |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ... |
|         | Alaska               | MA100 - MA109     | ✓                                | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ... |
|         | Arkansas             | MA390 - MA415     | ✓                                | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ... |
|         | :                    | :                 | ...                              | ... | ... | ... | ... | ... | ... | ... | ... |
| Local   | Allegheny County, PA | MA129             | ✓                                |     | ✓   |     | ✓   |     | ✓   |     | ... |
|         | Avency County, MD    | MA909             |                                  |     | ✓   |     | ✓   |     | ✓   |     | ... |
|         | Buck County, PA      | MA128             | ✓                                |     | ✓   |     | ✓   |     | ✓   |     | ... |
|         | :                    | :                 | ...                              | ... | ... | ... | ... | ... | ... | ... | ... |

FIG. 19

Background Modules 315 →

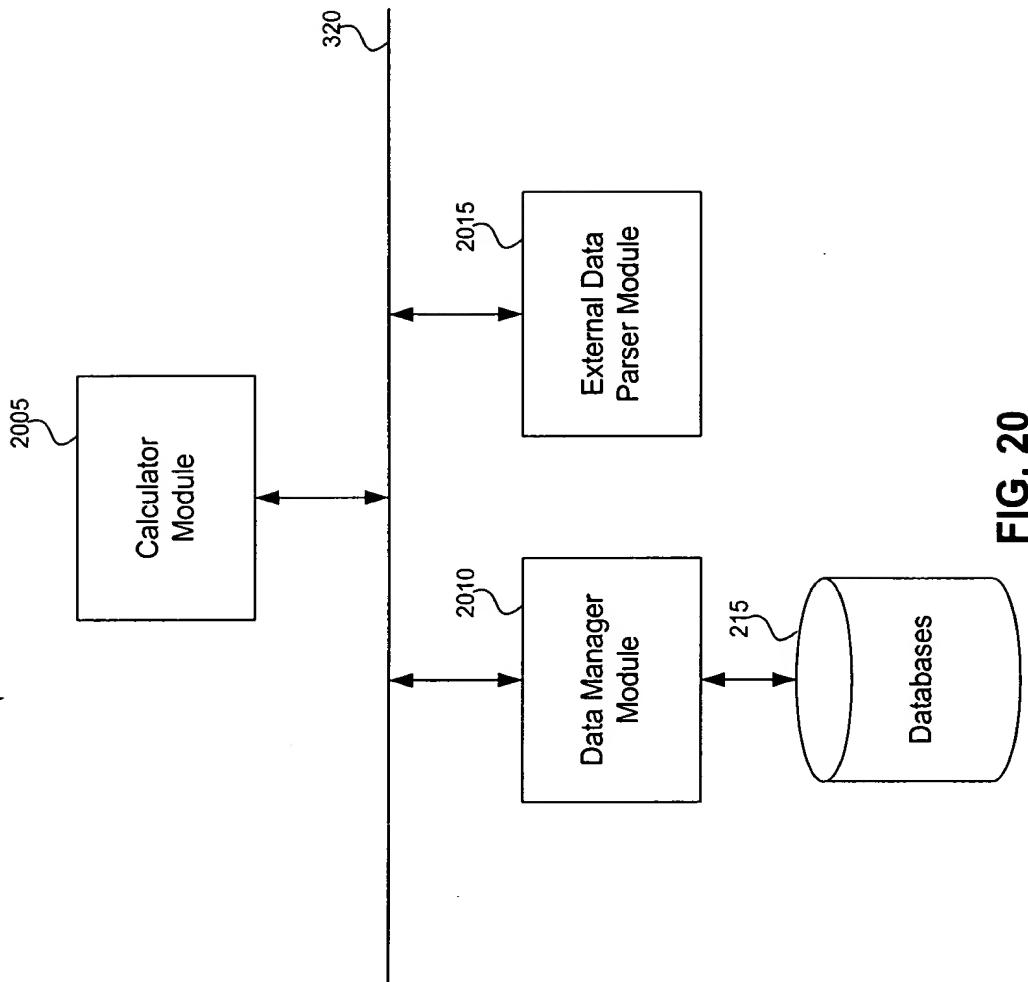


FIG. 20

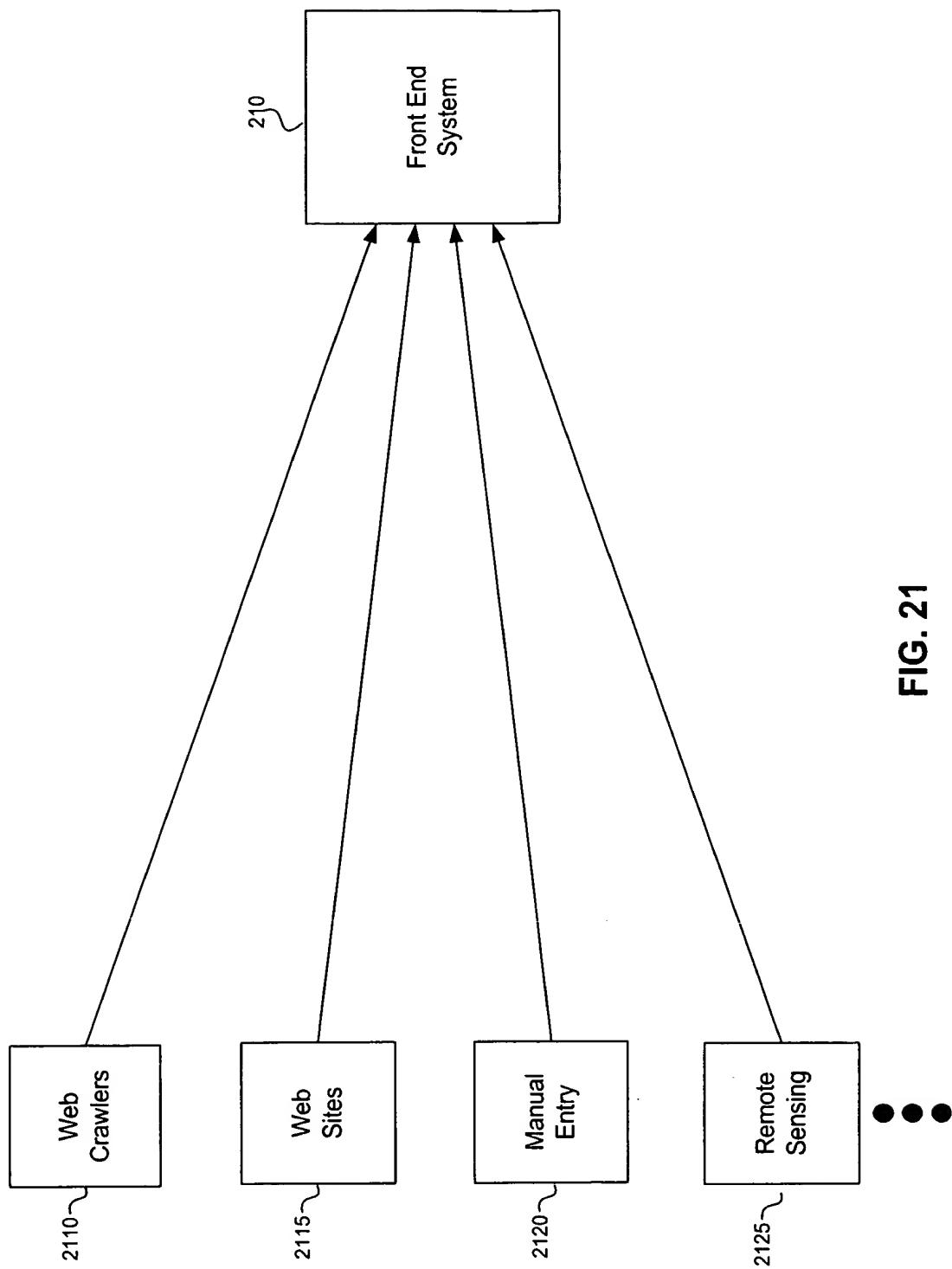


FIG. 21

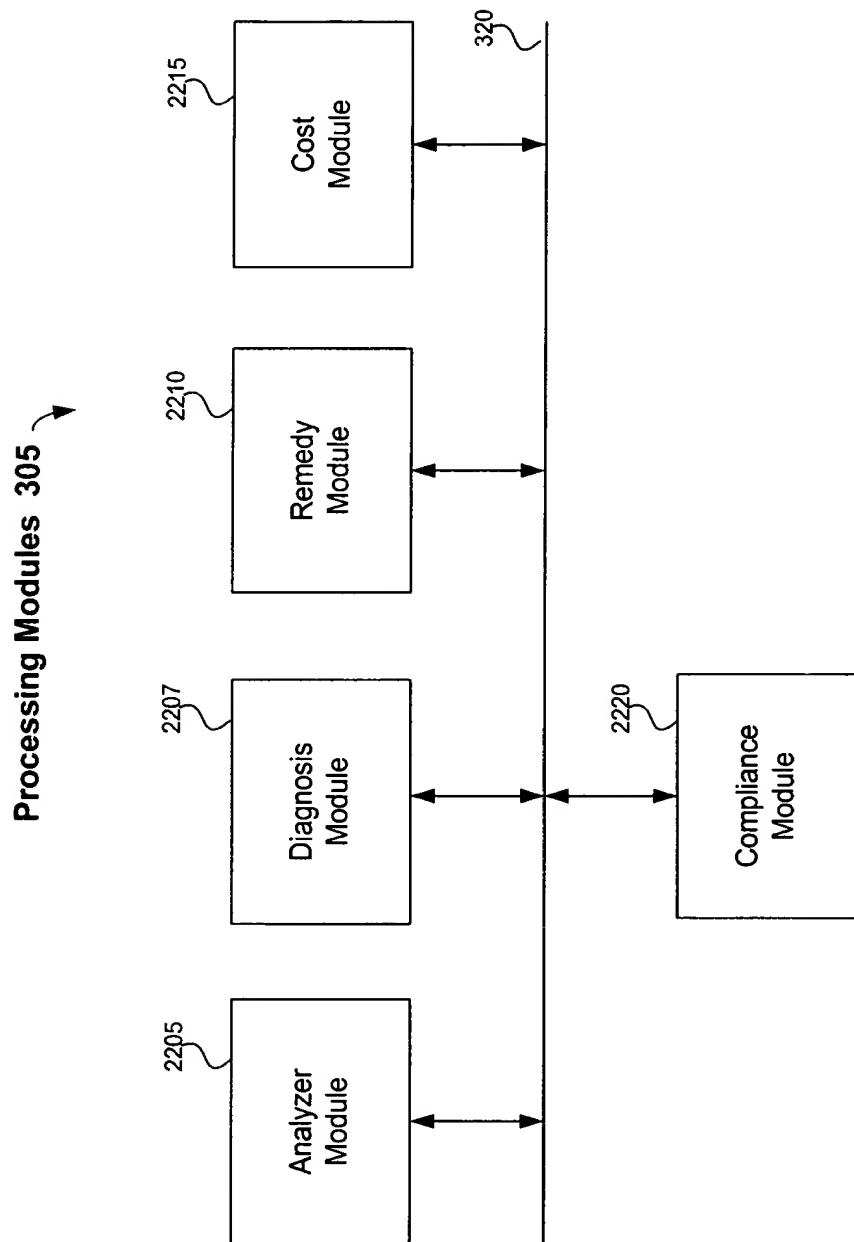


FIG. 22

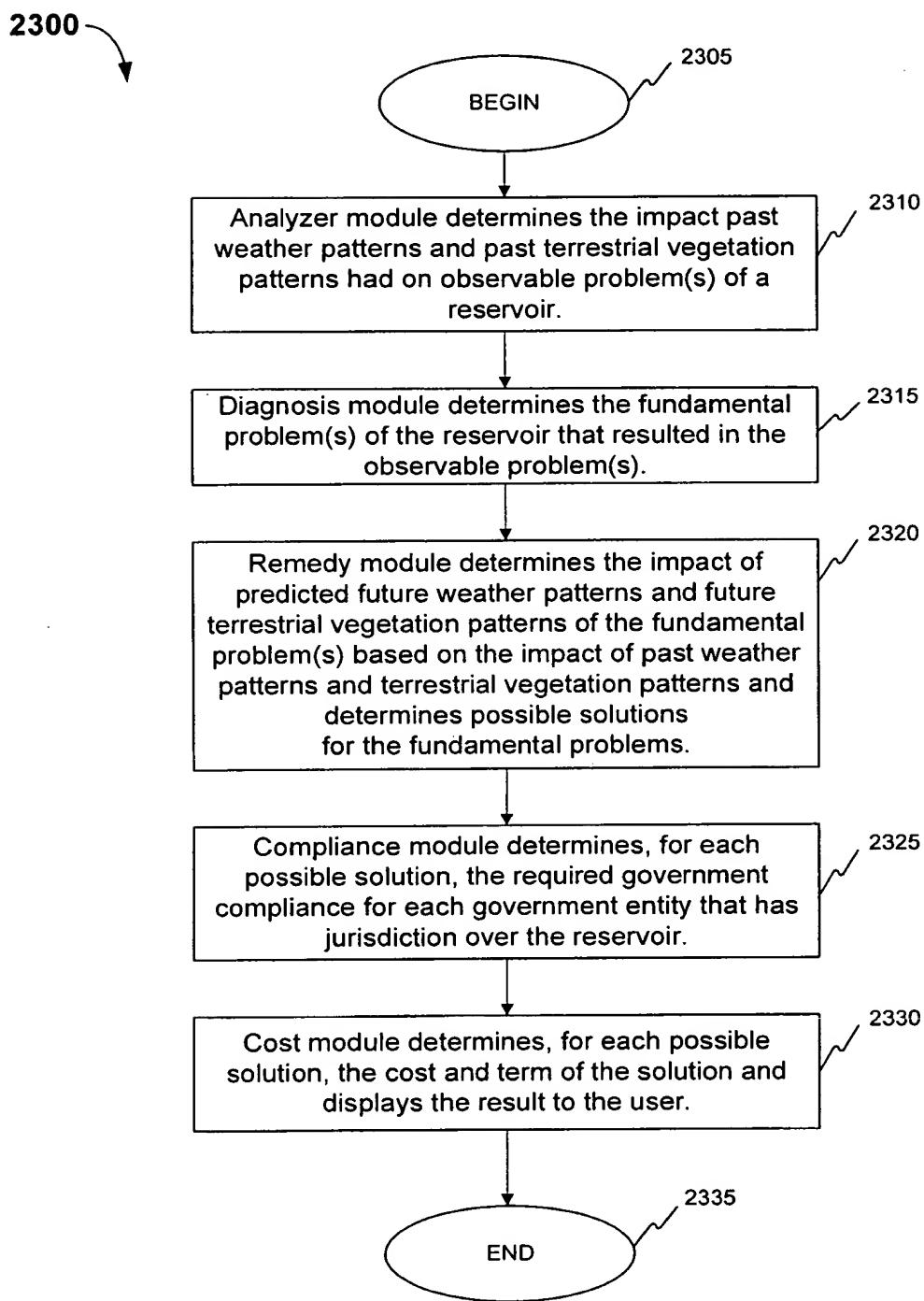
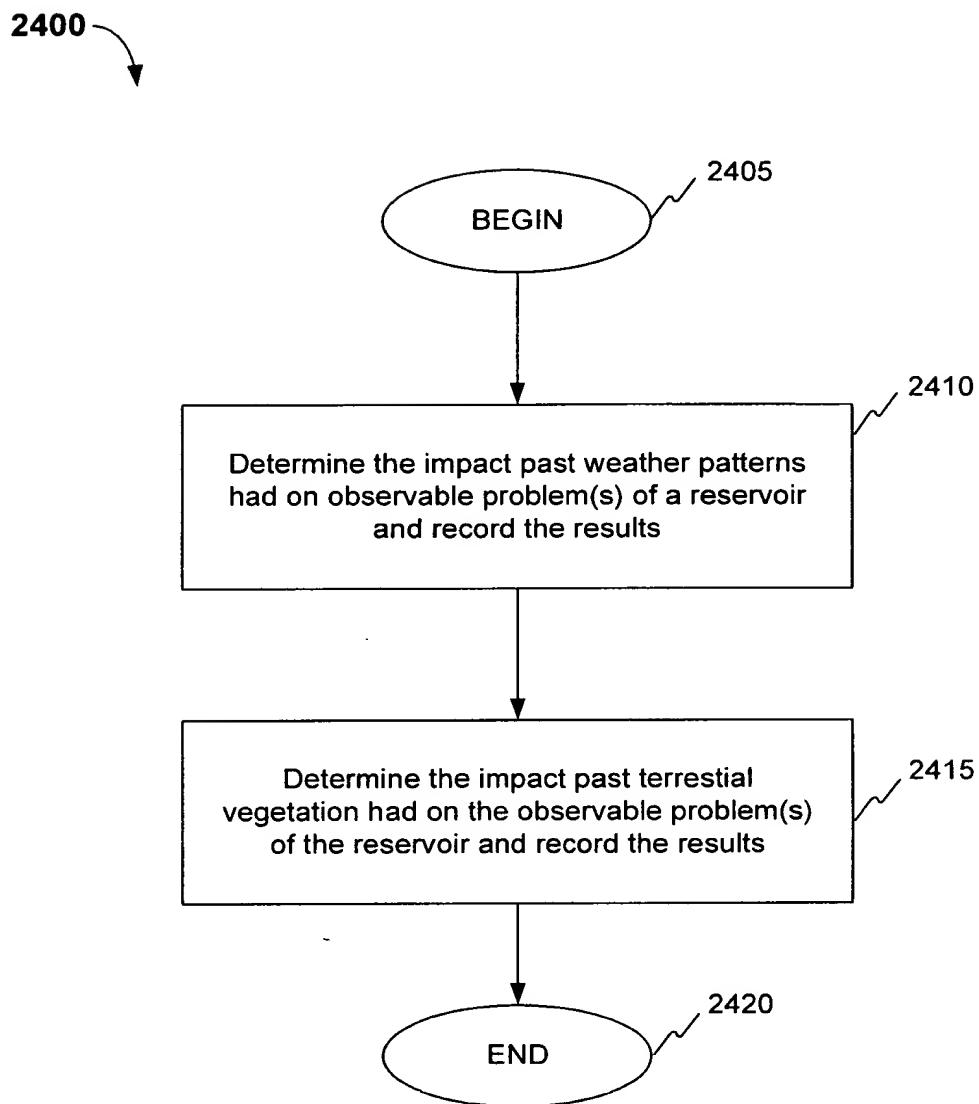
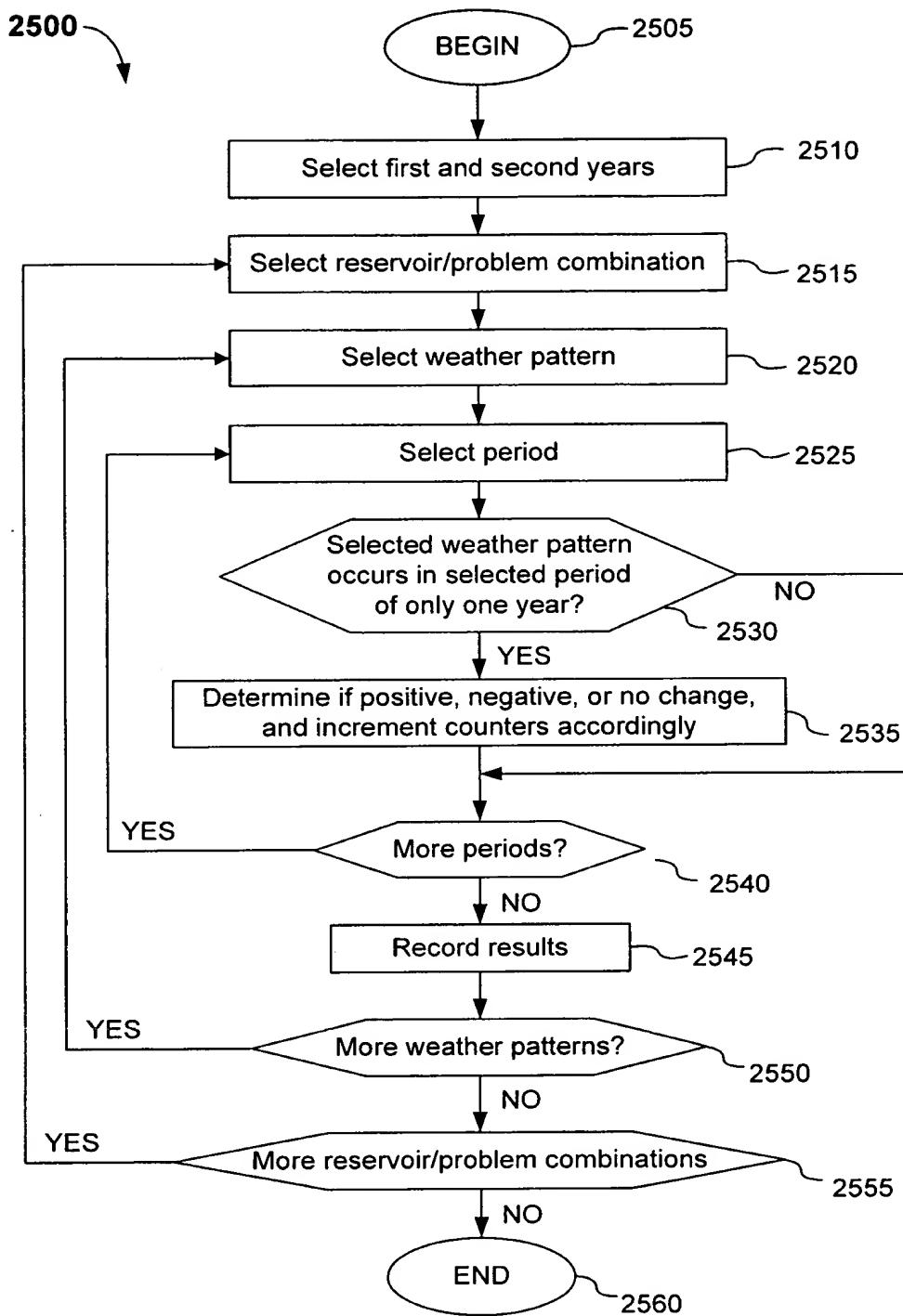


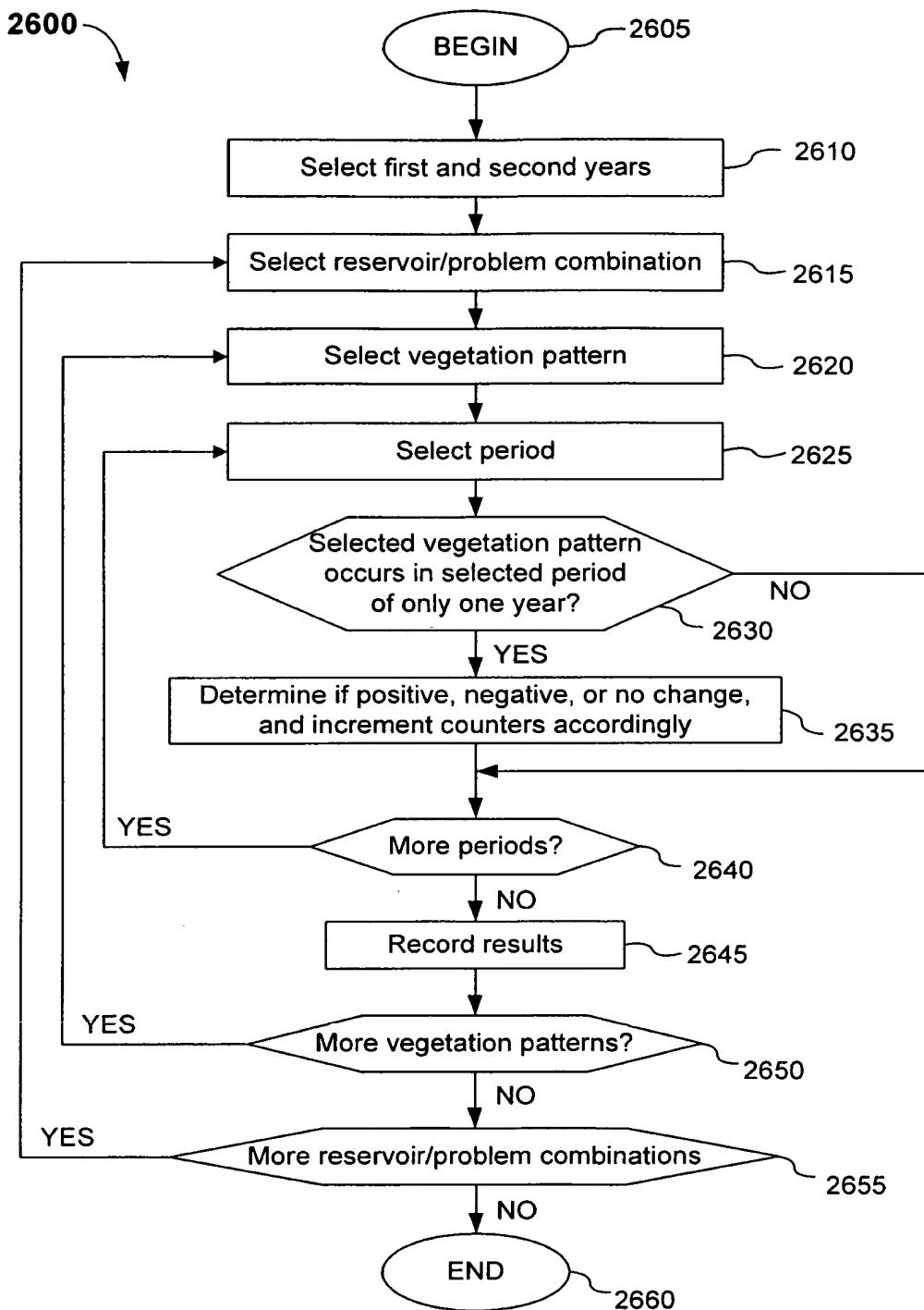
FIG. 23



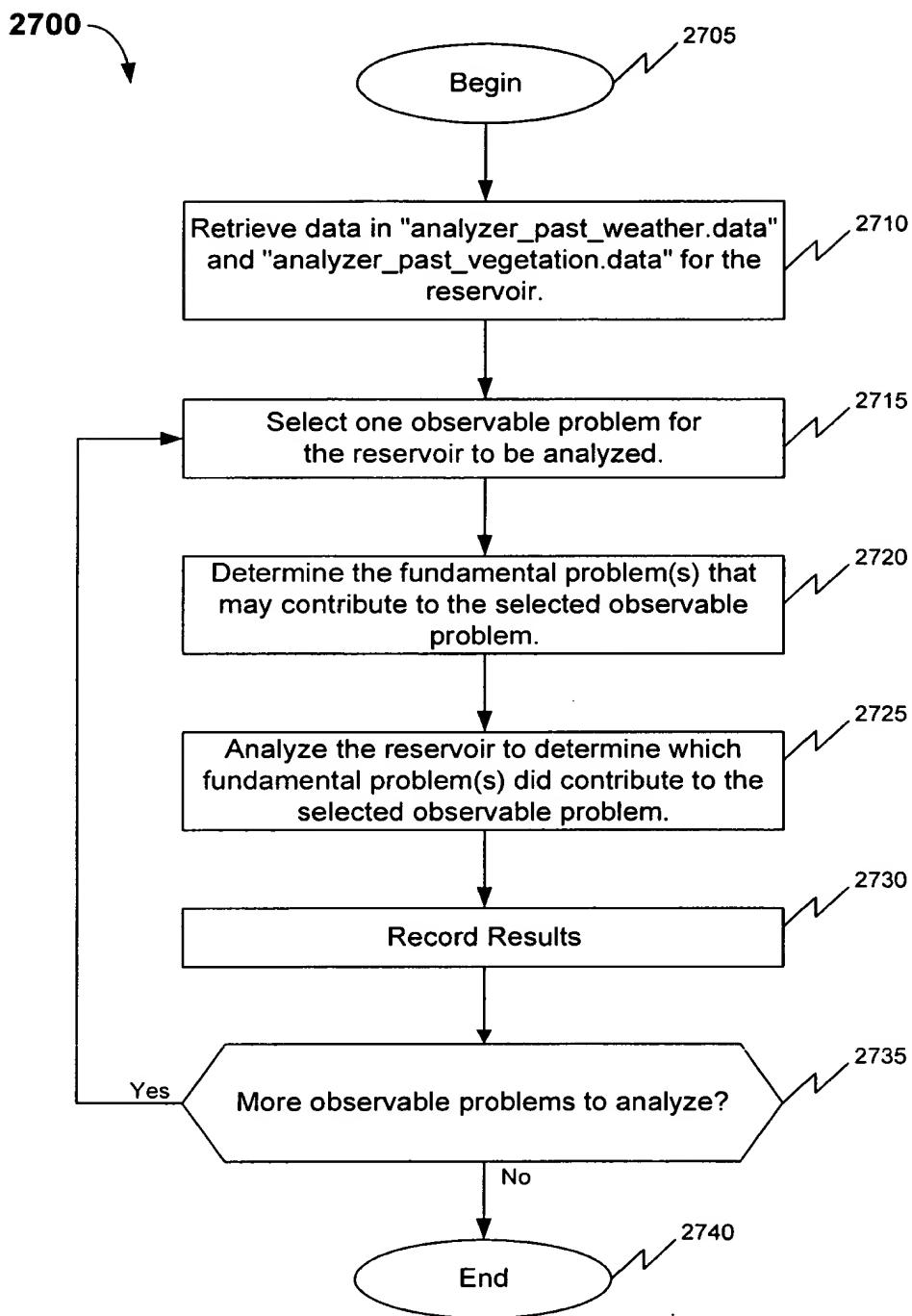
**FIG. 24**



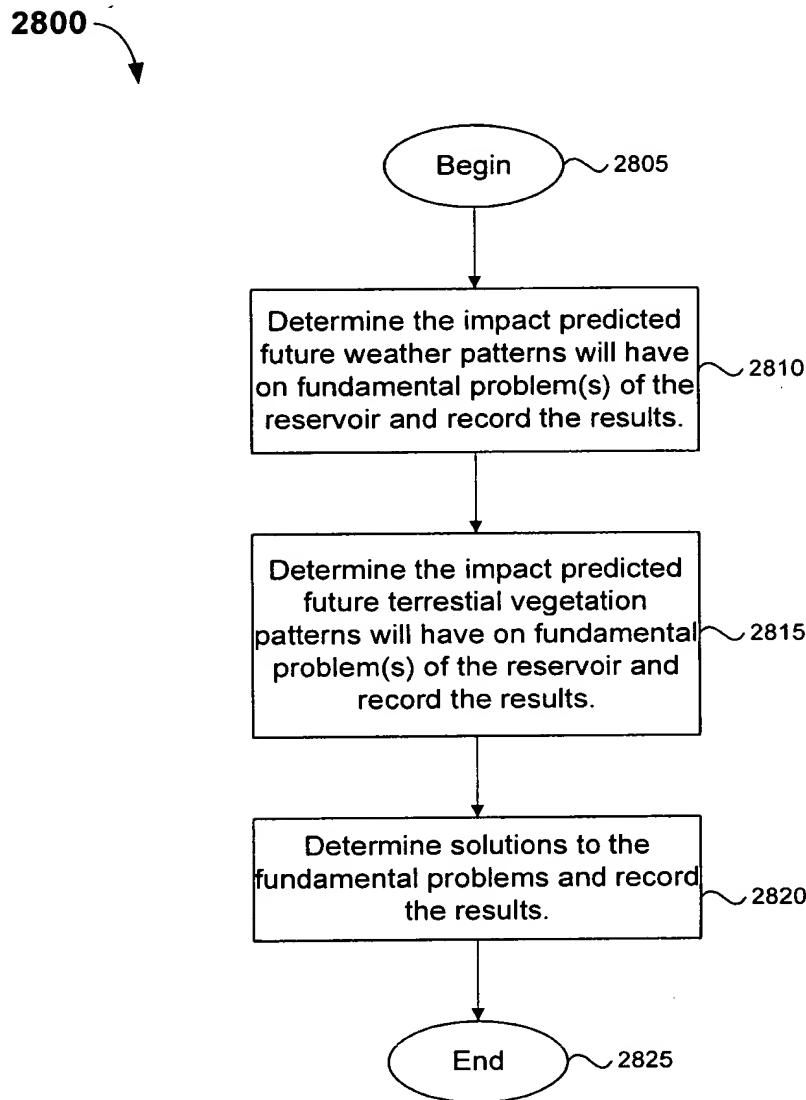
**FIG. 25**



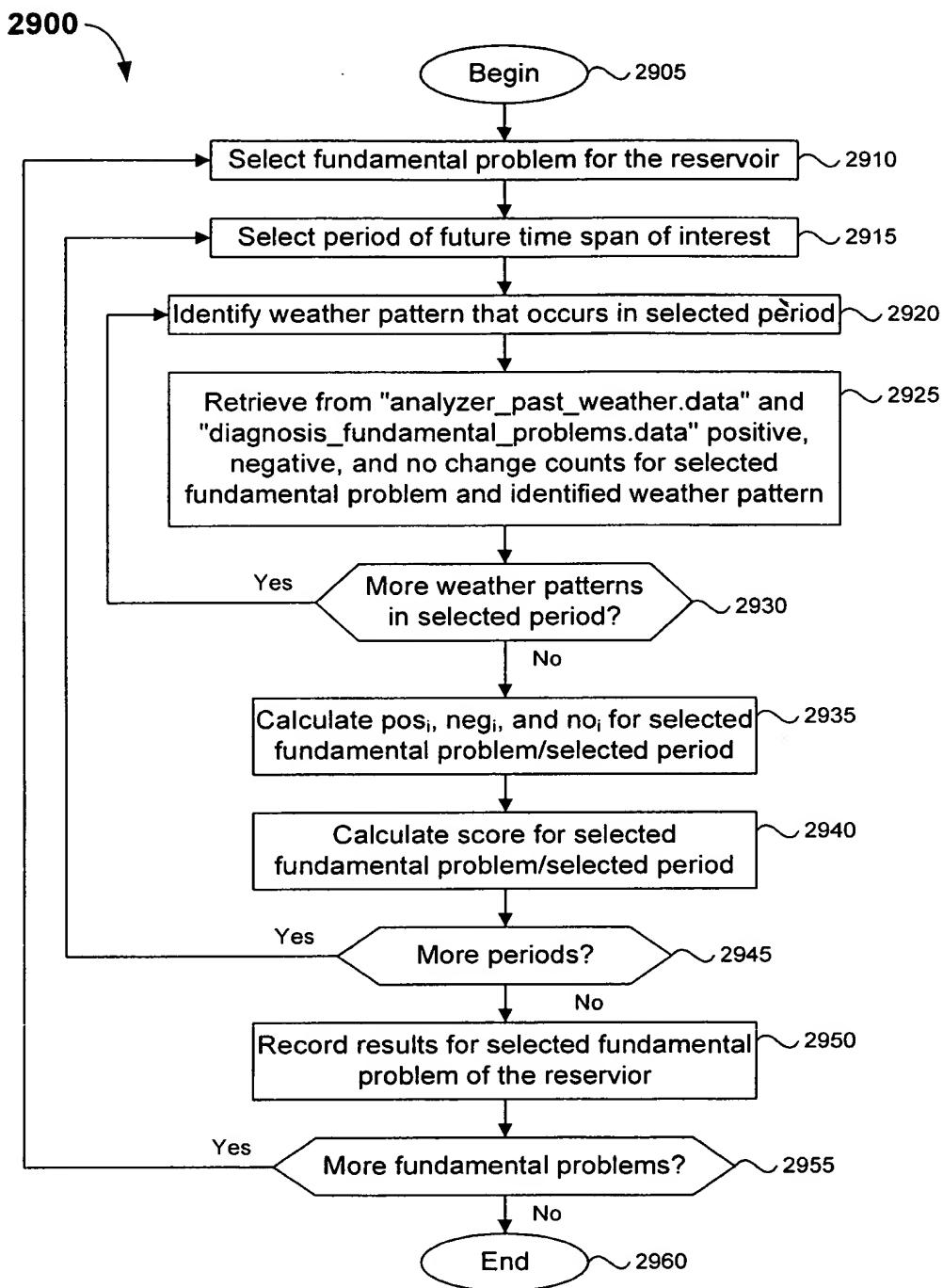
**FIG. 26**



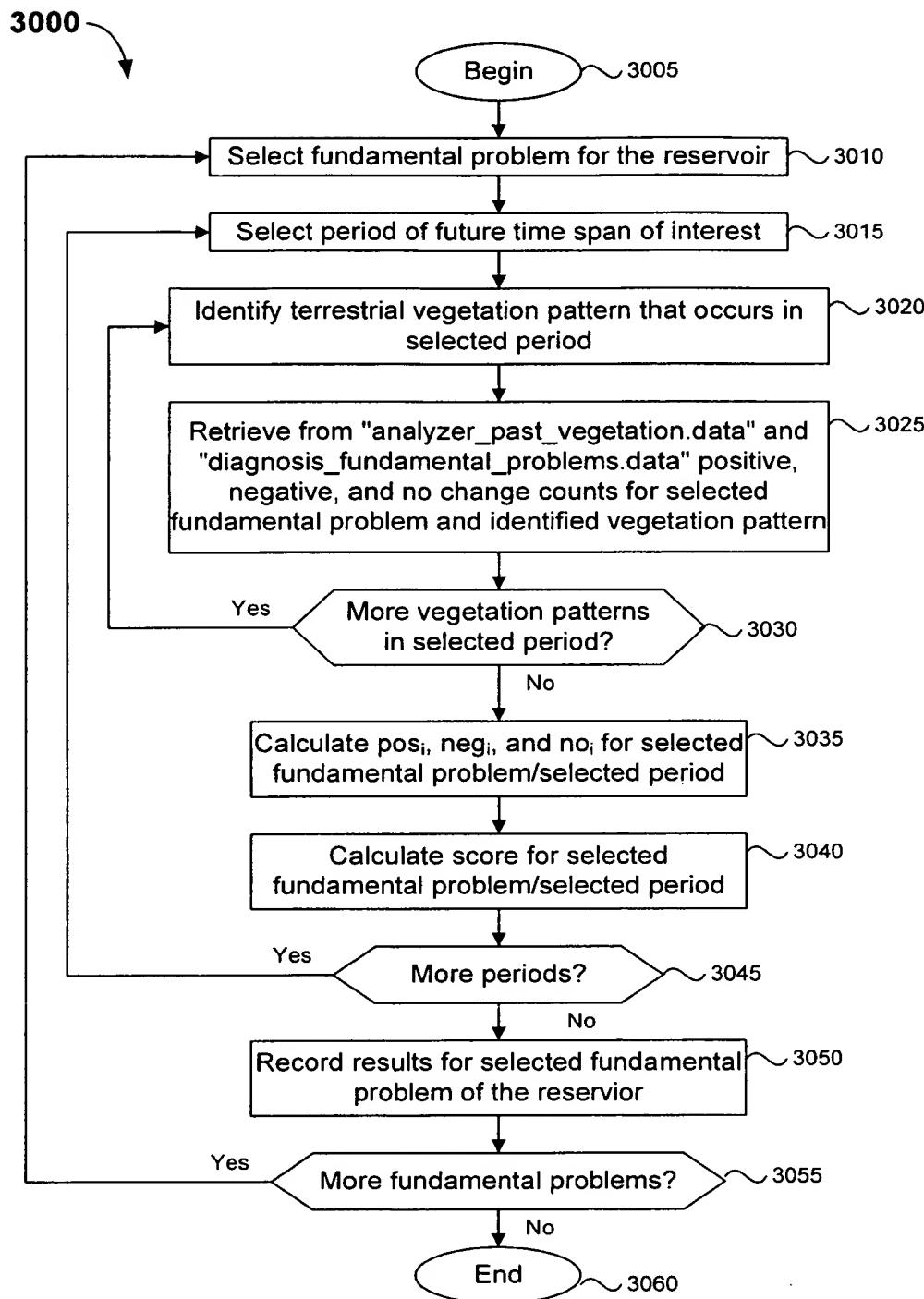
**FIG. 27**



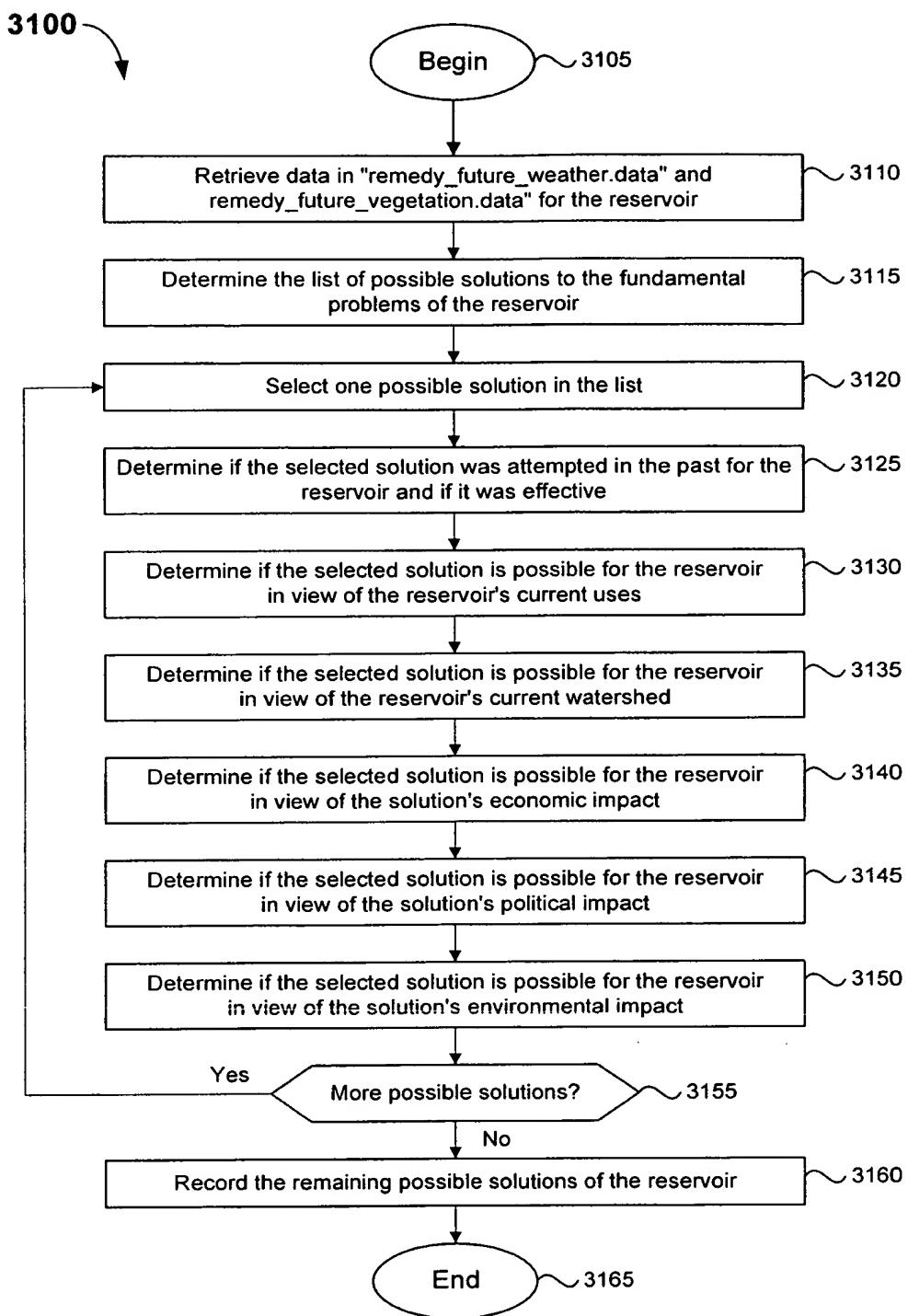
**FIG. 28**



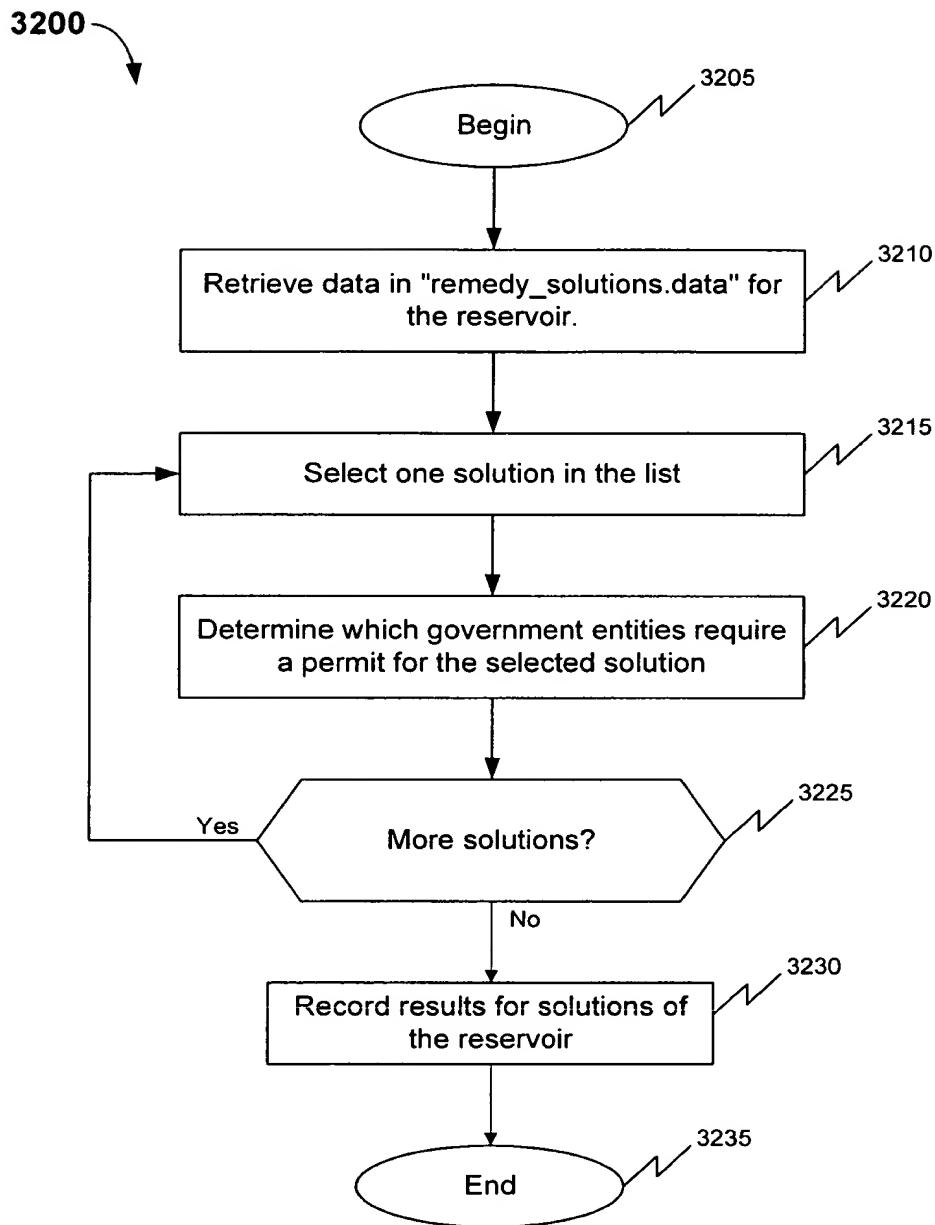
**FIG. 29**



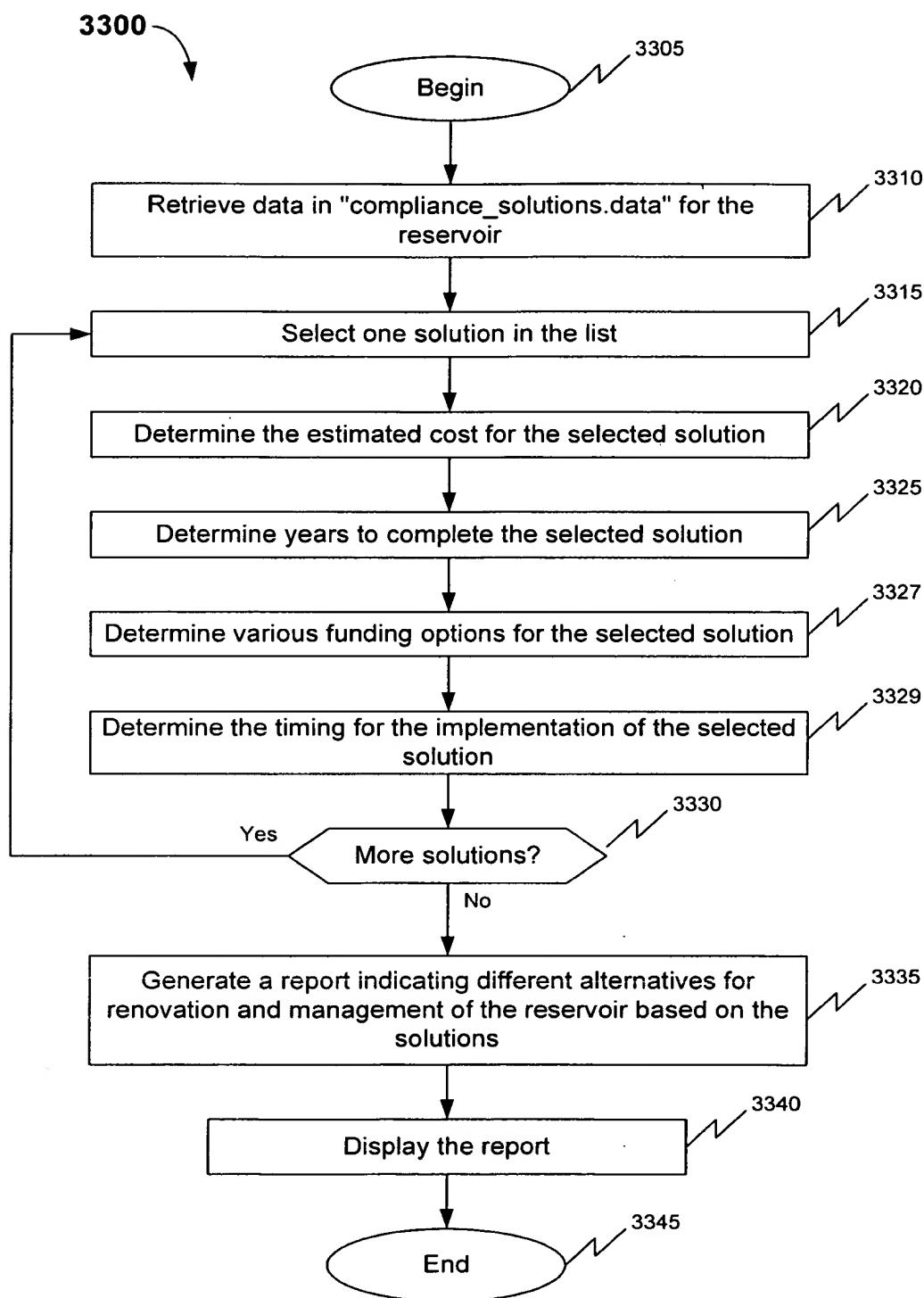
**FIG. 30**



**FIG. 31**



**FIG. 32**



**FIG. 33**

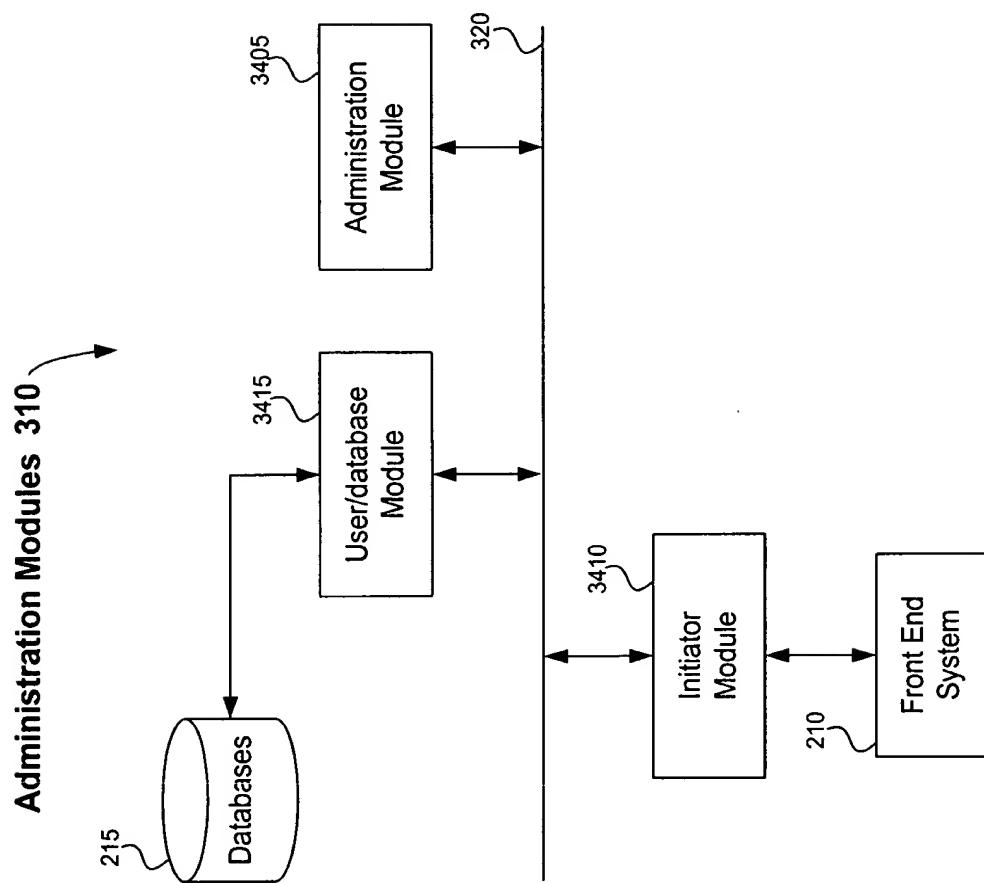
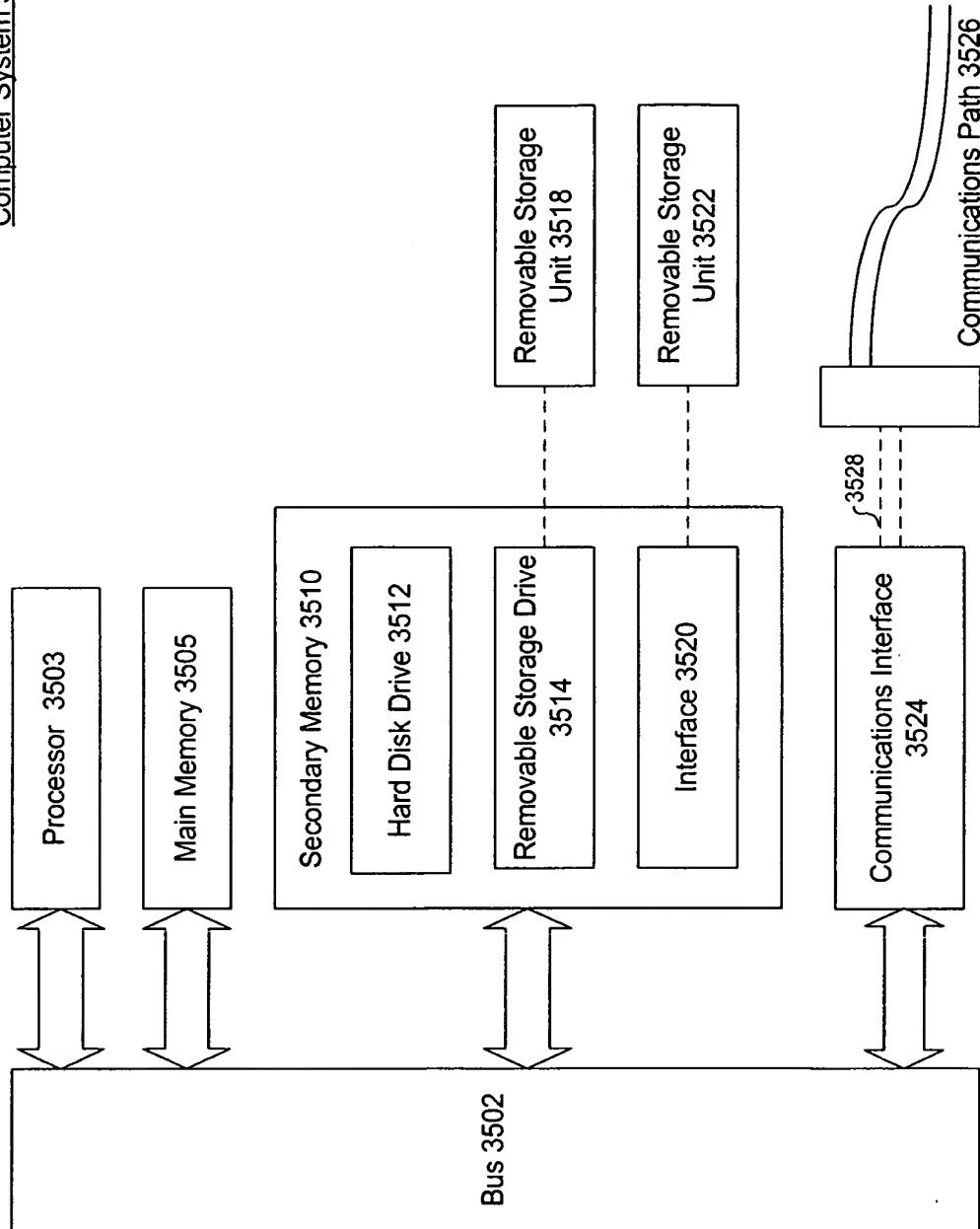


FIG. 34

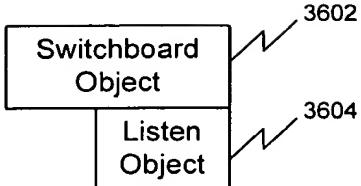
Computer System 3500



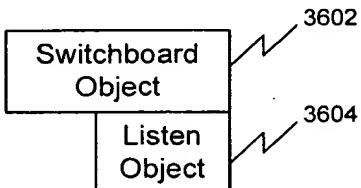
**FIG. 35**

**CLIENT**

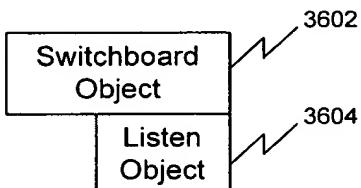
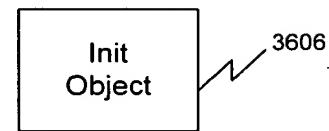
**SERVER**



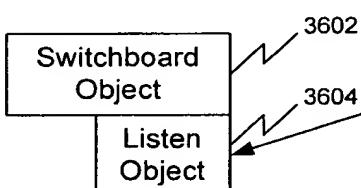
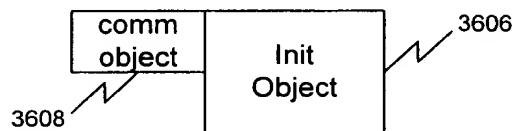
**FIG. 36A**



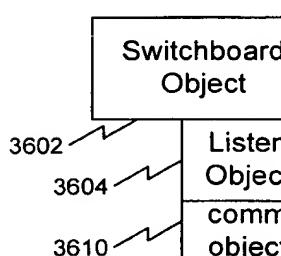
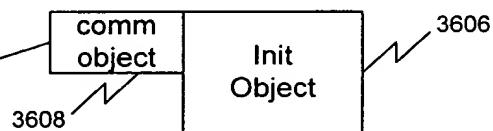
**FIG. 36B**



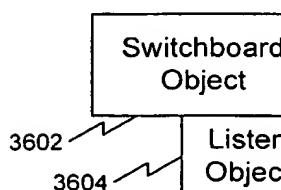
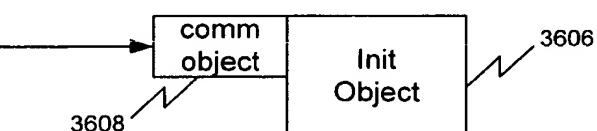
**FIG. 36C**



**FIG. 36D**



**FIG. 36E**



**FIG. 36F**

